Southeast University

Department of CSE

Lab Project Report

Title: Intruder Detection System Using Arduino Uno R3.

Course: Introduction to Embedded Systems Lab

Course Code: CSE3028.2

Section: 02

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Date of Submission:

12 October 2022

Title:

Intruder Detection System Using Arduino Uno R3.

Theory:

An intruder detection system is an embedded system that detects intruders at a given distance, the system we've developed can detect objects from 30cm which can easily be changed to the desired level, after detecting an object/intruder the system turns on an alert to let the users know about the occurrence, this embedded system utilizes a distance measurement sensor which can rotate to a certain angle and gets the distance of the objects near it. The system is useful for protecting important and expensive items from potential thieves, the system can also be used as a surveillance or radar system if desired.

Apparatus:

Hardware: Arduino Uno R3, Ultrasonic sonar sensor HC-SR04, Servo motor SG90, Temperature and humidity sensor DHT11, Active buzzer speaker, Red LED, 1/4w resistor, Breadboard, Jumper wires.

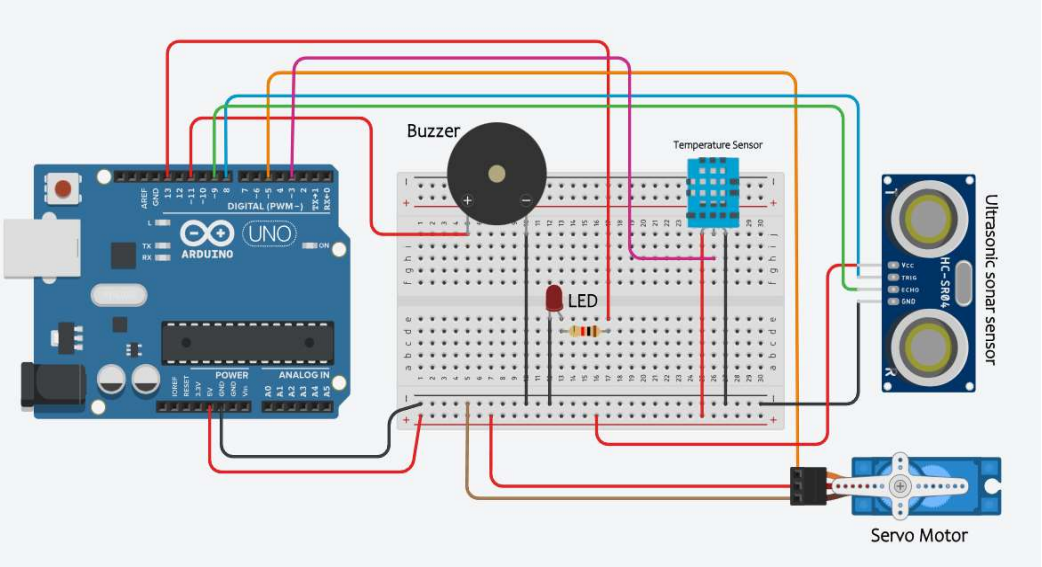
Software: Arduino IDE, DHT library, Servo library.

Implementation:

The system uses Arduino Uno R3 as the mainboard, the servo motor used here acts as the actuator of the sonar sensor which has been mounted on top of the servo motor, whenever the servo rotates to a certain degree the sonar sensor also rotates, and the DHT11 sensor acts as the dynamic temperature detection for the sonar system to work properly in any weather conditions, it is well known that sonar system emits ultrasonic waves continuously and the speed of the wave depends on the temperature of the surrounding environment. The active buzzer and the LED is there just for alerting mechanism, all the sensors and output devices get power

equally from the breadboard where a positive and negative column is directly connected to the Arduino's VCC and GND port respectively.

Circuit Diagram:



Details of the Circuit Diagram:

Ultrasonic sonar sensor: The VCC and GND pin of the sensor is connected to the positive and negative column of the breadboard respectively, the trig pin is connected to the 8th digital port and the echo pin is connected to the 9th port of the Arduino.

Servo motor: The VCC and GND wire of the motor is connected to the positive and negative column of the breadboard respectively, and the Pulse wire is connected to the 5th digital PWM port of the Arduino.

Temperature and Humidity sensor: The VCC and GND pin of this sensor is connected to the breadboard similarly to the sonar sensor and servo motor, and the Data pin is connected to the 3rd digital pin of the Arduino.

Active buzzer: The positive pin of the buzzer is connected to the 11th digital port of the Arduino Uno and the negative pin is connected to the negative column of the breadboard.

Red LED: The positive pin of the LED is connected to the 13th digital pin of the Arduino through a ¼ w ohm resistor and the negative pin is connected to the negative column of the breadboard.

Applications:

- Intruder detection
- Radar system
- Security system to protect expensive items

Source Code:

```
#include <dht.h>
#include <Servo.h>

dht DHT;
Servo servo;

int   tempSensorPin = 3;
int   servoPin      = 5;
int   servoDelay    = 12;
int   servoDeg      = 50;
int   trigPin       = 8;
int   echoPin       = 9;
int   ledPin        = 13;
int   buzzerPin     = 11;
bool  servoIncr     = true;
float velocity, distance, duration;

void rotateServo(){
  if(servoIncr){
    for(servoDeg; servoDeg<=130; servoDeg++){
      servo.write(servoDeg);
      if(servoDeg%5==0){
```

```
        calculateDistance();
        alertOn();
      }
      delay(servoDelay);
    }
  }
  else if(!servoIncr){
    for(servoDeg; servoDeg>=50; servoDeg--){
      servo.write(servoDeg);
      if(servoDeg%5==0){
        calculateDistance();
        alertOn();
      }
      delay(servoDelay);
    }
  }
  servoIncr = servoDeg>=130 ? false : servoDeg<=50 ? true : servoIncr;
}

void calculateVelocity(int temp){
   velocity = 332 + (0.6 * temp);
   velocity = (velocity/1000000.00)*100;
}

void calculateDistance(){
   digitalWrite(trigPin, LOW);
   delayMicroseconds(5);
   digitalWrite(trigPin, HIGH);
   delayMicroseconds(10);
   digitalWrite(trigPin, LOW);
   duration = pulseIn(echoPin, HIGH);
   distance = (velocity * duration)/2.00;

   Serial.print("Distance = ");
   Serial.println(distance, 4);
}
```

```
void alertOn(){
  if(distance<=30){
    digitalWrite(ledPin, HIGH);
    tone(buzzerPin, 500);
    Serial.println("Intruder Detected!");
  }
}

void setup() {
  Serial.begin(9600);
  servo.attach(servoPin);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(ledPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);
}

void loop(){
  int var = DHT.read11(tempSensorPin);
  delay(500);

  digitalWrite(ledPin, LOW);
  noTone(buzzerPin);

  int currTemp = DHT.temperature;
  Serial.print("Current Temperature: ");
  Serial.println(currTemp);

  calculateVelocity(currTemp);
  Serial.print("Velocity = ");
  Serial.println(velocity, 4);

  rotateServo();
}
```

Serial Monitor Output:

```
COM3
Current Temperature: 30
Velocity = 0.0350
Distance = 228.1650
Distance = 227.3600
Distance = 225.8725
Distance = 225.6275
Distance = 143.8850
Distance = 142.9400
Distance = 142.9400
Distance = 145.6525
Distance = 142.9575
Distance = 143.9375
Distance = 142.5375
Distance = 143.1150
Distance = 144.1650
Distance = 196.1925
Distance = 37.4500
Distance = 37.4325
Distance = 15.9425
Intruder Detected!
Current Temperature: 30
Velocity = 0.0350
Distance = 18.8475
Intruder Detected!
Distance = 144.7250
Distance = 40.5475
Distance = 142.8350
Distance = 39.6550
Distance = 144.7425
Distance = 142.4325
Distance = 143.3075
Distance = 143.8150
Distance = 141.8200
Distance = 144.2175
Distance = 143.9375
Autoscroll  Show timestamp
```

The physical image of the Intruder detection system:

Discussion:

The servo motor of this embedded system can rotate from 50 degrees to 130 degrees and vice versa, the ultrasonic sonar sensor is mounted on the top of the servo motor so when the servo rotates the sonar rotates along with it, for every multiplier of 5 for a certain degree the sonar emits ultrasonic sound and then the distance is calculated, from 50 to 130 and 130 to 50-degree rotation the sonar sensor calculates distance 32 to 34 times and looks for an object within 30cm if an object is detected within the range this system turns on the Buzzer and Red LED.

Limitations:

- The servo motor used in the system cannot rotate 360 degrees
- The system cannot detect objects which move at a high speed
- The range of the sonar sensor used for this system is only 2cm to 400cm
- If the system calculates distance for every degree change of the servo motor's actuator then the servo rotation becomes very slow
- To solve slow servo rotation the distance measurements were reduced, the system only measures when the rotated degree is a multiplier of 5
- The system has a delay of 500ms for every repetition of the actual operation

Conclusion:

By doing this intruder detection system project we learned how embedded systems works and how to develop one from scratch, we also learned how an intrusion detection system works and how it can be used for different security purposes. The various tools we used to develop this system gave us a thorough understanding of their working mechanisms, uses, and limitations.